and Seidel have made full use of the available inventory of materials to present a lucid, plausible and realistic understanding of a remarkable man, the institution that indelibly bore his imprint and his interactions with his cultural milieu. No hagiography this, for as Swift treated his Gulliver, so the authors give a full account of the human Lawrence: his prodigious entrepreneurial skill, his unbridled midwestern boosterism and his almost religious belief in the endless fruits of "progress." They show that these traits did more to propel Lawrence's vision than did his considerable talents as a practicing physicist. The authors present the laboratory's technological process and product in painstaking, but never dull, detail. Their copious collection of well-selected diagrams and photographs provides further leavening for an already zesty text. That they relate all this arcanum to the larger, evolving social and institutional context is a masterful achievement.

Lawrence and His Laboratory is a wonderful read. The authors' seamless, sprightly and irreverent prose offers many delights. The descriptions of the laboratory and its habitues are so human in scale that a nonscientist can peruse them with pleasure and profit. Further, there are many new insights and much valuable information here for those interested in our roots as physicists. Seidel and Heilbron have even gotten the physics right!

By indifferent promotion and inept production, the publisher has failed this important and interesting book. Few, if any, reviews of this work have appeared in the general print media, so its existence will be mainly known to students of science and scientists. The index does not include many entries and citations, a flaw that reduces its usefulness as a reference.

Nonetheless, if the two remaining volumes of this trilogy live up to the high standard of the first, then the authors will have erected an imposing edifice of 20th-century history. In progress is a second book, which deals with the essential contributions of Ernest and his "boys" to far-flung war efforts, their reunion on the Hill, the laboratory reaching its apogee and finally Lawrence's death. The planned third volume will trace the meander of Lawrence's institution to its current state of aimless mediocrity as his strong, single-minded leadership has been increasingly replaced by the organizational chart and bureaucratic bloat. With the tall timber being harvested but not replaced, squaw carpet abounds.

Physics of High-T_c Superconductors

J. C. Phillips

Academic, San Diego, Calif., 1989. 393 pp. $49.95 hc ISBN 0-12-553990-8

There exist now some half-dozen larger reviews or books related to the physics of high-T_c cuprates. It is with the sentiment "another one" that the undersigned took the book by J. C. Phillips in hand and . . . read it cover to cover, sentence by sentence. Why? Being in a sense a newcomer to the field of superconductivity, the start was obvious: He was attracted by the first two chapters on the old materials and their theory. In reading them, he learned some aspects that had escaped him previously and sensed that the author of the book had a deep understanding, which he conveyed easily, both with respect to the materials as well as the theoretical results concerning them. Especially the anharmonicity of the "old" high-T_c materials was substantial, including the related lattice softening and instabilities, their pressure dependence and T_c enhancement. This is specifically so for the elements nitrogen and oxygen on one side, and the d-transition elements on the other. The chemical physics aspects related to the above properties guide the reader through the whole book. In this context the word "fictive phonons" enters. The undersigned, coming from the ferroelectricity field, is more used to models of "order–disorder dynamics," whose meaning is nearly the same: the "rattling" Slater ions.

The new materials are exposed in Chapter 3. First the remarkable properties of the Chevrel phases are described which form a link to the more recent discoveries. This link is not only historical but also conceptional, in that a link Pb atom is found between Mo_6S_8 clusters in $PbMo_6S_8$ ($T_c = 15.3$ K). Then the description passes on to the $BaPbBiO_3$ perovskites, which are the true predecessors of the cuprates and reach T_c of about 30 K for $K_{0.3}Ba_{0.7}BiO_3$. Phillips then describes the structural, electronic and superconducting properties of the La_2CuO_4 and $YBa_2Cu_3O_7$ cuprates. He does this with considerable insight into the materials. Of course, as the chapter was obviously written quite early, the results from ceramic samples occupy quite some space. Nevertheless, essential structural and transport properties are well brought out, such as the near linear in-plane temperature dependence of the resistivity above T_c.

The properties of the bismuth- and thallium-based compounds are reviewed in the last chapter, 9. They form, together with the lanthanum and yttrium cuprates, the new class of high-T_c materials. One would wish—for a new edition—their description to follow Chapter 3. The reason for their late presentation in the book is that they became known when the volume had reached completion. Most of the data presented in the book are of US origin. Practically none stem from Japan or Europe. In that sense, the book represents the US viewpoint and was of interest to the undersigned per se. As there has been such an intensive effort on the cuprates worldwide, the choice of representative US results does not appear as a large fault, but it is, from a science–culture point of view, interesting. As an example, one can cite from Chapter 3, page 87: "No stable Cu^{3+} compounds are known." The contrary is true. The $LaCuO_3$ and $LaSrCuO_4$, with Cu^{3+} cuprates synthesized in Talence, France, with the collaboration of J. B. Goodenough in 1973, are the *precursors* of the discovery of superconductivity in cuprates. After the Talence achievement, groups working on catalysis synthesized mixed-valence Cu^{2+}–Cu^{3+} cuprates, first in Russia, then in Caen, France. Becoming aware of the latter investigations was important for the ongoing search for superconductivity in cuprates at the IBM Zurich Research Laboratory in Rüschlikon, Switzerland. No wonder the discovery came as a big surprise for the scientific community in Japan and the US. (Goodenough was by then in Oxford, England.)

The material insight of the author, a well-known theoretician, is remarkable. This is omnipresent in the theoretical chapter 4 and would be really worthwhile reading for some of his theoretical colleagues. As he states, "The complexity of these materials are such that one can ill afford the luxury of pursuing unproven 'interesting' alternative theories to BCS." He diligently exposes the materials' electronic structures and their chemical bonding origin, and quite early he emphasizes the highly polarizable quantum wells that lie between the chains and the Y nonpolarizable walls. This includes the O(4) apex oxygen frequency peak in the density of states. One is certainly willing to be liberal about the emphasis of his defect-enhanced electron–phonon interaction to yield strong in-plane coupling $\lambda = 3$ to 10, which he deduces.

Strong points are made in section 12 of the theoretical chapter on Exotic

and Ultimate Causes. Therein he states: "The semiconductive antiferromagnetic phase is *irrelevant* for discussing the ground state of the superconducting phase. Actually both phases are separated by a *first order phase transition*." In the same section, Phillips emphasizes that the electron–phonon interaction is some 20 times stronger than the electron–magnon and electron–exciton couplings based on central-field considerations. After these perspectives, the last section (13) on Selective Phonon Condensation follows naturally. As already alluded to, Phillips prefers to use a fictive phonon model rather than the anharmonic double-well potentials used in ferroelectrics to deal with the large-amplitude anharmonic displacements as indicated by diffraction experiments. However he also discusses the anharmonic models: Both models stem from nearly equal oxygen p–copper 3d energies. This chapter, which also includes some numerical estimates, is a highlight of the book and, as stated, to most theoreticians relatively novel. Indeed, in view of the more recent developments, it contains quite some foresight.

There follows a series of short chapters, 5 to 10, on the isotope effect, lattice vibrations, optical spectra, tunneling and relaxation studies by ultrasound and nmr as well as one on materials morphology. Space does not permit us to dwell on them, but the author makes quite a number of interesting points worth reading, this despite that, since his *oeuvre*, more detailed, substantial data have been reported. Two remarks may be in place: To the taste of the undersigned, the author introduces too late in the book the observed strongly anisotropic coherence lengths, especially the extremely short one of approximately 2 Å perpendicular to the CuO_2 planes. This property is quite crucial for these cuprates, underlying both basic and application properties. Also, and related to the science–culture remarks made earlier, the electron-loss spectroscopy results of the Karlsruhe group, known since fall 1987 and unique worldwide, should have been included in the description. These experiments gave clear evidence for the presence of oxygen holes and the p-type character of carriers.

The book ends with three really useful appendices on Macroscopic Parametric Relations, Microscopic Theory and Crystal Chemistry. Villars' theory appears in the last of these, allowing one to systematize the superconductors in terms of valence electrons, electronegativity and differences in spectroscopic radii.

With his remarks, the undersigned hopes to have interested both newcomers to the high-T_c field as well as accomplished experimentalists and theoreticians in Phillips's book and maybe to have helped the author in one way or another to make some changes if he considers preparing a second edition.

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From Paradox to Reality: Our Basic Concepts of the Physical World

Fritz Rohrlich
Cambridge U. P., New York, 1989 [1987]. 227 pp. $14.95 pb
ISBN 0-521-37605-X

Fritz Rohrlich is a distinguished theoretical physicist well known both for his work in quantum field theory and for his textbooks on quantum electrodynamics (with Josef Jauch) and classical electrodynamics. He has now undertaken the important task of communicating to nonscience students and to an educated lay audience an appreciation of the nature of science and of scientific theories through an examination of the conceptual revolutions brought about by the watersheds of thought in 20th-century physics: relativity (both special and general) and quantum mechanics.

In the preface, Rohrlich tells us that this book grew out of a course, Concepts in Contemporary Physics, for nonscience students, that he has given at Syracuse University. Mathematics, used only sparingly in this book, is rarely essential for following his discussion and, when employed, is confined to elementary high-school algebra. The book is divided into three main sections, covering the nature and construction of scientific knowledge, relativity and quantum theory. Rohrlich emphasizes that this text is *not* a popularization of relativity and quantum theory, but an examination of the nature of the scientific enterprise and of related issues in the philosophy of science as illustrated by the development of these two modern theories. For that reason, this review will focus on the discussion of the nature of the scientific enterprise as presented by Rohrlich, rather than on the details of the physics.

To provide a conceptual back-